INSTALLATION AND OPERATING INSTRUCTIONS MANUAL
NORWEGIAN CRYSTALS NOOR SOLAR PANELS
For the installation of photovoltaic panels certified according to UL 1703 and IEC 61215/61730

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I. INTRODUCTION

Thank you for choosing high-efficiency Noor Solar panels from Norwegian Crystals. Noor panels are designed, engineered and crafted for generating years of durable and reliable power. They are manufactured to the highest quality and environmental standards. Installed and maintained correctly, and in accordance with guidelines presented herein, Noor solar panels will deliver clean renewable energy sustainably for many years.

Please read carefully and become familiar with the installation and operating instructions provided in this manual before installing, operating or maintaining the photovoltaic system. This manual contains critical information on safety, as well as detailed instructions for installing, operating and servicing the Noor panel. Failure to do so can lead to personal injury or property damage and could void panel warranty.
Keep these instructions handy and in a safe place for future reference.

LIABILITY DISCLAIMER

Since compliance with this guide and the conditions and methods of installation, operation, use and maintenance of the modules are not verified or monitored by Norwegian Crystals AS, Norwegian Crystals AS accepts no liability for damage arising through improper use or incorrect installation, operation, use or maintenance. Norwegian Crystals reserves the right to make changes or amendments to this manual at any time, without prior notice.

This document may be available in different languages. In case of conflict only the English version is legally binding and shall apply.

LIMITED WARRANTY

The Norwegian Crystals limited warranty is available to download from www.crystals.no. Ignoring the instructions in this manual may be classed as improper installation or use and invalidate the warranty. If you have any questions about installation and the warranty validity, please contact Norwegian Crystals' technical support noor-support@crystals.no.

II. SAFETY

GENERAL

The operation and maintenance of a PV system requires a substantial level of technical knowledge. Only a qualified electrician should carry out the work on an electrical installation and commissioning.

Applicable permitting requirements must be checked with local authorities before attempting to install or maintain PV modules.

Installers are responsible for the safe and effective installation and operation of the photovoltaic system and for adhering to all local and national standards and regulations for solar systems, building construction, electrical design, fire, working at heights, and fall protection.

Ensure that Noor panels are in a suitable condition for use and appropriate for the particular installation and environment. All equipment should be properly maintained and inspected prior to use. Use only parts that comply with the specifications set out in this manual and ensure a safe installation in all aspects of the electrical array.

Rooftop PV systems should only be installed on buildings or structures that have been formally analyzed for structural integrity, and confirmed as sound and capable of bearing the weight of installers and required system components by a certified building specialist or engineer. Remember to isolate the system from the grid before carrying out any maintenance or repair work.

Solar panels should not be handled or installed under adverse conditions, including without limitation strong or gusty winds, and wet or frosted roof surfaces.

The solar panel should not be altered in any way. To disassemble, modify or alter the panels or labels in any way will void the warranty.

ELECTRICAL

Solar panels will produce a voltage even under low levels of irradiance, making them an electrical hazard during installation as well as operation. Adhere to the following points in order to avoid electrical arcing and personal injury due to electrical shock:

- Cover solar panels with opaque material during installation and maintenance.
- Refer to the manual of the inverter manufacturer for system assembly instructions.
- Never connect or disconnect solar panels from the inverter while the inverter is connected to the grid.
- Remove/open the inverter AC fuse/circuit breaker before disconnecting from the grid.
- After switching off the inverter, as well as before working on the inverter, make sure you allow sufficient time for the high voltage components to discharge, as recommended by the inverter manufacturer.
- Inspect all cables and connectors for damage before assembly.
- Do not insert any conductive items into the connectors.
- Ensure that no soil or dirt has entered the solar panel connectors before assembly.
- Ensure that cables, connectors and tools are dry during assembly.
- Only use appropriate, insulated tools for assembly.
- Use proper personal safety equipment such as insulating gloves.
- Do not wear metallic jewelry during mechanical and electrical installation.
- Do not disassemble the modules.
- Never remove parts or name plates/labels fitted by the manufacturer.
- Only use flawless modules (If the panel front glass is broken or laminate back sheet is damaged, it can expose personnel to hazardous voltages).
- Do not expose modules to artificially concentrated sunlight.

FIRE GUIDLEINES

Noor solar panels have a Class C Fire classification in accordance with the IEC 61730-2 certification. The fire rating of this module is valid only when mounted in the manner specified in the mechanical mounting instructions.

Follow these fire safety guidelines when installing:

- Apply local/national fire safety guidelines and requirements for photovoltaic systems installed on any building or structure.
- Ensure that the system design allows for the installation to be easily accessed in the event of a building fire.
- Check with local authorities for regulations concerning setbacks or other placement restrictions applicable to roof-mounted arrays.
- DC ground fault interrupters are recommended for additional safety. This may be required by local and national codes.
- Roof-mounted systems must always be installed over a fire-resistant surface rated for the application.
- Ensure at all times that there is a minimum distance of 60 mm between the solar panel's frame and the mounting surface. This allows for free air circulation.

III. ELECTRICAL INSTALLATION

Noor panels are rated for use in electrical application Class A: Hazardous voltage (IEC 61730: higher than 50V DC; EN 61730: higher than 120V), hazardous power applications (higher than 240W) where general contact access is anticipated (panels qualified for safety through En IEC 61730-1 and -2 within this application class are considered to meet the requirements for safety Class II). The maximum reverse current is 15A and the maximum series fuse rating is 15A.

Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at the standard test conditions. The requirements of the National Electrical Code (NEC) in Article 690 shall be followed to address these increased outputs. In installations not under the requirements of the NEC, the values of Isc and Voc marked on this module should be multiplied by a factor of 1.25 when determining component voltage ratings, conductor ampacities, overcurrent device ratings, and size of controls connected to the PV output.

The following points must be adhered to in order to ensure that the solar installation operates with the highest possible energy yield and to avoid damage to any individual component of the installation:

- Do not connect panels with different electrical properties in the same string.
- The solar panels can be connected in series to produce a desired system voltage. When doing so, ensure that the solar panels have the same current rating.
- The solar panels can be connected in parallel to produce a desired system current. When doing so, ensure that the solar panels have the same voltage rating.
- The number of panels connected in series is restricted by the maximum system voltage of the inverter, or the maximum system voltage of the solar panel (600V UL/1000V IEC), whichever is lower.
- Operating conditions in the field can cause the solar panels to produce a higher voltage and/or current than the rated values. A safety margin of 125% is therefore required when dimensioning component voltage ratings, conductor amperage fuse sizes and size of controls connected to the PV output.
- Other system components must be chosen in accordance with local regulations.
- System wiring should be made with solar grade cables having a minimum cross section of 4 square millimeters or 12 AWG.

IV. MECHANICAL INSTALLATION

ORIENTATION

To maximize system output, panels should be installed at the optimum orientation and tilt angle specific to system location. A qualified system designer can calculate this.
Optimal mounting position of panels should results in the sun's rays falling perpendicular (i.e. at 90°) to the surface.
All panels in a string should, wherever possible, have the same orientation and tilt to ensure the system does not underperform due to mismatched outputs.

TRANSPORT, TEMPORARY STORAGE AND HANDLING

Noor modules must be transported in the supplied packaging until they are ready for use. Make sure pallets are properly secured during transportation. Modules should always be transported in a vertical position to avoid microcracks.

Panels should be handled with utmost care and always shielded from damage. Pay special attention to the warnings on the packaging and to the enclosed unpacking instructions.

Follow these guidelines when unpacking, transporting, storing or mounting the panels:

- Record serial numbers in the system documentation.
- Always transport modules in a vertical position.
- Always lift and carry the module with both hands.
- Never lift the panel by the junction box or use the cables as a grip.
- Be careful not to drop the panel as it may provoke unseen damage.
- Do not let the panel sag or bow under its own weight when carried.
- Do not apply or stresses or loads to the panels (front-side or backside).
- Do not apply sharp objects, paints or adhesives to the back-sheet.
- Do not use sharp or pointy objects to mark the panel.
- Do not stand or walk on the panels (front-side or backside).
- Do not stack the panels unprotected.
- Store in a cool, dry, ventilated room.
- Keep all electrical contact areas clean and dry.
- Wear clean, non-slip gloves during all transport and installation work to prevent cut injuries from the panel edges.
- Avoid contaminating the solar glass with fingerprints to avoid soiling/damaging the special anti-reflective coating.
- Never apply paints, adhesives or detergents to the laminate.
- Do not alter the frame in any way, for example by drilling additional holes.

ENVIRONMENTAL FACTORS

Noor panels' operating temperatures must be between -40 and +85°C.

Solar panels are not regarded as explosion-proof. The panels are not suitable for installation in potentially hazardous locations nor should they be installed in the following locations:

- Near inflammable gases and vapors, e.g. gas stations, gas containers or spray paint facilities.
- Near open fire or flammable materials.
- Under water or in water features.
- Exposed to sulfur e.g. near sulfur springs or volcanoes.
- Exposed to harmful chemicals.

Ensure panels are not exposed to direct contact with salt water/spray and avoid installation in areas subject to high salt mist content.

V. MOUNTING INSTRUCTIONS

PANEL MOUNTING

The Noor solar panel has a junction box rated at IP 65 and can be mounted in both landscape and portrait orientations. When mounted in portrait, the junction box may be facing up or down on the underside of the module. There are different methods to mount the Noor solar panel on the substructure:

- By clamping the panel on either the long part or the short part of the frame
- By bolting the module from the back using the provided mounting holes on the flange of the frame
- By using an insertion system.

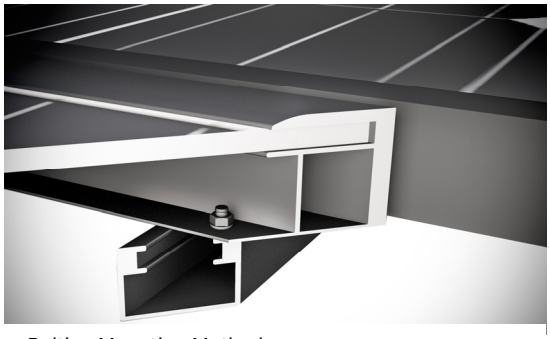
The module is considered to be in compliance with UL 1703 only when the module is mounted in the manner specified by the mounting instructions below.
Any module without a frame (laminate) shall not be considered to comply with the requirements of UL 1703 unless the module is mounted with hardware that has been tested and evaluated with the module under this standard or by a field Inspection certifying that the installed module complies with the requirements of UL 1703.
For rooftop mounting, the module must be mounted on a fire resistant roof covering with a sufficient rating for the intended application. The rooftop slope needs to be less than 5 in/ft (127 mm/305 mm) to maintain the fire class rating.

A minimum of two clamps per side are needed in case of short side and long side clamping. All four mounting holes need to be used when bolting the module directly to the mounting structure.

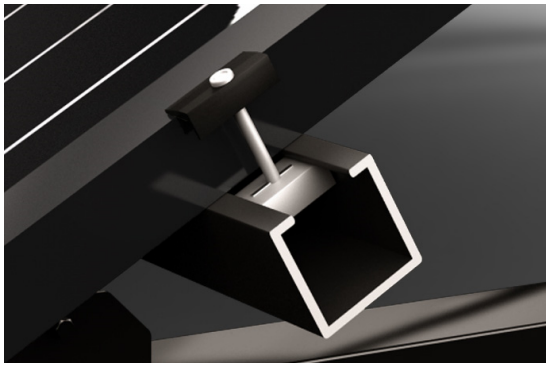
- The required tightening torque for bolting the frame directly is 20 Nm (14.8 lb ft). Use M6 bolts made of V2A.
- If using clamps, apply the torque recommended by the clamp manufacturer.
- Always use corrosion proof material for installation.
- To ensure proper module ventilation, a minimum distance of 60 mm is required between roof or any other substructure and the solar panel's frame.
- Clamping outside the approved green or yellow zones is not permitted (see diagram on next page).
- Where there is a potential risk for extreme snow loads and/or snow slides, countermeasures must be taken to ensure that module frames on lower-roof edges cannot be bent or displaced.

Modules in Portrait Orientation

Modules in Landscape Orientation



Bolting Mounting Method

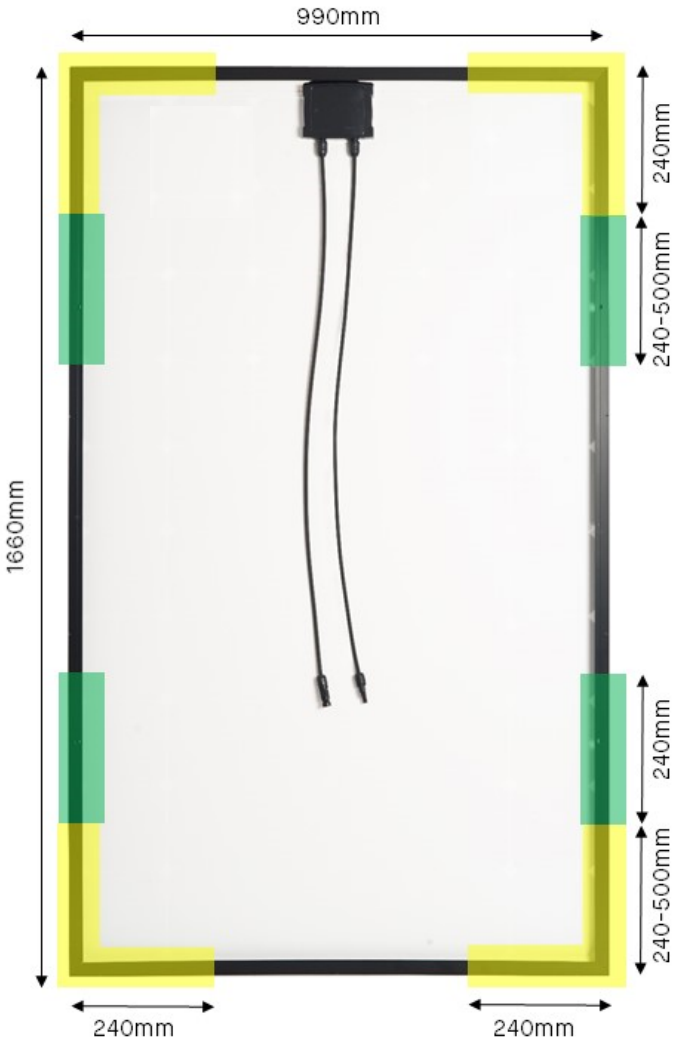


Clamping Mounting Method

APPROVED CLAMPING ZONES

Green zone: Clamping within the green zone (240 - 500 mm from the corner on the long side of the module) is certified for design loads up to 5400 Pa (550 kg/m2)

Yellow zone: Clamping within the yellow zone (0 - 240 mm from the corner on both the long side and short side of the module) is certified for design loads up to 2400 Pa (244 kg/m2)



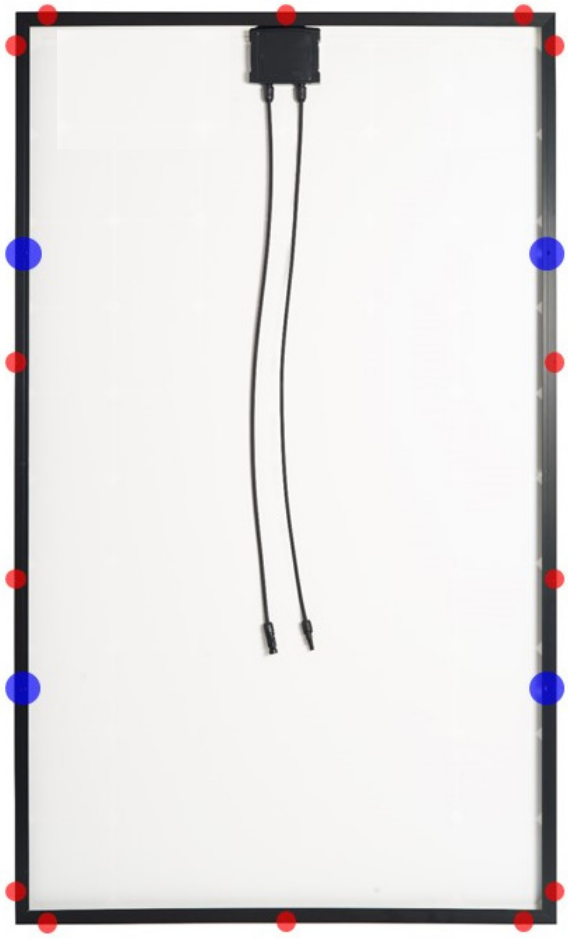
Yellow and Green Approved Clamping Zones

DRAINAGE AND MOUNTING HOLES

Mounting hole positions are shown in blue, and drainage holes are shown in red.

Installation by usage of mounting holes is certified for design loads up to 5400 Pa (550 kg/m2)

Ensure that the drainage holes at the corners of the panels are not covered by the mounting structure.



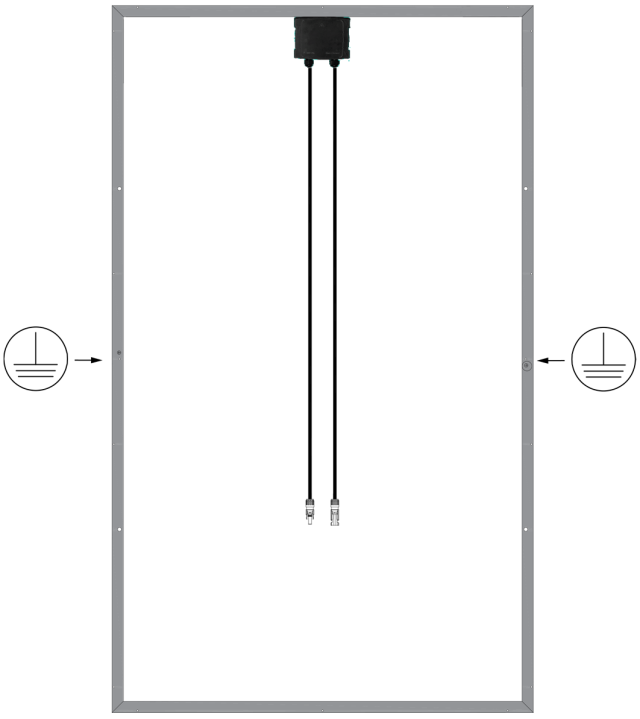
Drainage Hole (red) and Mounting Hole (blue) locations

GROUNDING

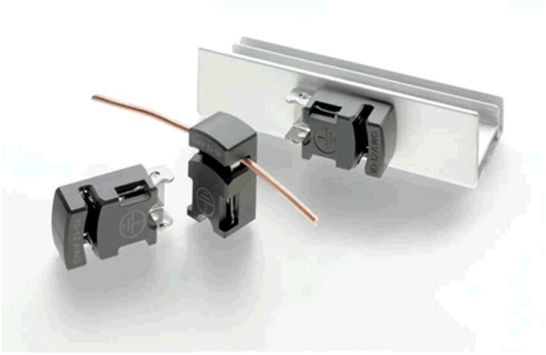
A module with exposed conductive parts is considered to be in compliance with UL 1703 only when it is electrically grounded in accordance with the instructions presented below and the requirements of the National electrical Code.

Grounding of the NOOR solar panel frame is not obligatory, however it is recommended as an added security to reduce the risk of electric shock. Local grounding standards and regulations must be followed. The grounding connections between the modules must be checked and accepted by a qualified electrician. Furthermore, only a qualified electrician may connect the main grounding. In the USA and Canada, a grounding method approved by Underwriters Laboratories (UL) is obligatory.

Grounding holes are provided at the flange of the module frame. These holes are marked by a grounding symbol. For grounding we recommend the Solklip grounding terminal with integrated thread-cutting screw, (UL 467 approved, UL number E69905), manufactured by Tyco Electronics.



Grounding Hole locations



Recommended Grounding clip: Tyco Solklip

VI. MAINTENANCE, DECOMMISIONNING AND RECYCLING

We recommend that the installer or other qualified professional inspect the PV systems periodically to ensure that:

- All cables and connector attachments are undamaged, tightly secured and corrosion free.
- The mechanical integrity of the cables is intact.
- No sharp objects are in contact with the PV module surfaces.
- No panels have a broken glass panel.
- PV modules are not shaded by unwanted obstacles and/or foreign objects.
- Mounting and grounding components are tightly secured and corrosion free.

Defects should be remedied immediately.

CLEANING

Noor panels are designed for ease of maintenance. The hydrophilic nature of the glass improves self-cleaning from normal rainfall if the panels are installed at a sufficient angle, suggested greater than 10%. The lower the inclination the more cleaning will be required.

Periodic cleaning is recommended, as over time, dirt and dust can accumulate on the glass surface of the module, resulting in cell shading and power output reduction, or even cause further damage.

In order to reduce the potential for electrical and thermal shock, cleaning of the panels should take place during early morning or late afternoon hours when solar radiation is low and the modules are cooler.

To clean the front or rear of the panels, preferably use deionized water at ambient temperature and a sponge, microfiber cloth or a soft brush. Rainwater, tap water or diluted alcohol may also be used as a secondary solution. Water with high mineral content or physical contaminants may leave deposits on the glass or back-sheet surface and is not advised.

If further cleaning is required use a mild, biological and biodegradable washing-up liquid. Repeat the cleaning process if soiling remains. For more persistent soiling, you may use isopropyl alcohol (less than 10% concentration. Always rinse the panels abundantly with water.

Do not use a high-pressure hose, a power wash, steam or corrosive materials. This may damage the panel, the laminate or the cells and remove the anti-reflective coating.

A rubber squeegee may be used to wipe the panel surface. Apply a downward motion from the top of the panel, without applying pressure, to remove any residual water. Panels can be left to dry or wiped dry with a chamois. Using aggressive tools or abrasive materials could scratch or damage the glass surface.

Never attempt to clean a PV module with broken glass or other signs of exposed wiring, as this presents a shock hazard.

DECOMMISSIONING

Apply the same care and safety precautions when dismantling the PV systems as during their installation. Hazardous voltage can be generated even after system disconnection. Follow the live electrical equipment safety regulations.

RECYCLING

Norwegian Crystals has made every effort to ensure panel packaging is kept to a minimum. The paper and cardboard packaging can be recycled and the protective wrapping and panel separating blocks are also recyclable in many areas. Recycle according to local guidelines and regulations.

DISPOSAL OF OLD ELECTRICAL AND ELECTRONIC EQUIPMENT
(APPLICABLE TO E.U. COUNTRIES ONLY)

For installations in the European Union, this product is subject to WEEE regulations. The above symbol indicates that this product shall not be treated as household waste and must be disposed of at an appropriate collection point for the recycling of electrical and electronic equipment. The recycling of the different components and materials will help to conserve natural resources.

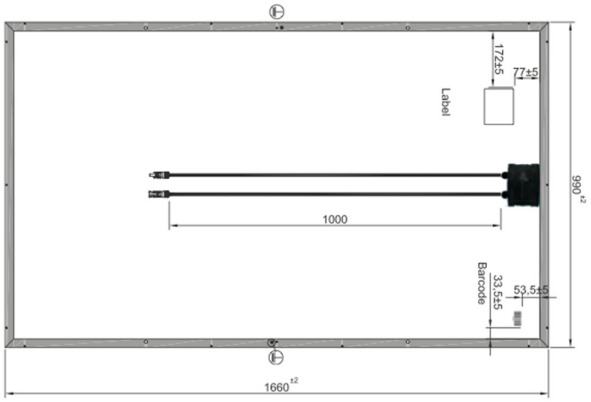
By ensuring Noor panels are disposed of correctly, you will help prevent potential negative consequences for the environment and human health which could otherwise be caused by inappropriate waste treatment.

For more information about recycling of this product, please contact your local recycling authorities or recycling center.

VII. PANEL INFORMATION

Technical characteristics

Panel dimensions (mm)



MECHANICAL DATA	
Dimensions	1660 x 990 x 40 mm ±2
Area	1.64 m^2
Weight	20 kg

COMPONENTS	
Silicon/Wafer	Norwegian Crystal p-type
Cell Type	PERC technology 3 strings of 20 cells with bypass diodes
Glass	3.2 mm glass with AR treatment
EVA	High UV transmission and PID resistant
Backsheet	Triple layer polyester design, white or black
Frame	Anodized aluminum. Crimp free
Junction Box	MC4 compatible (4 mm^2), IP65

MAXIMUM RATINGS	
Operational Temperature	-40 to +85 °C
Maximum System Voltage	1000 V
Maximum Reverse Current	15 A
Maximum Series Fuse Ratings	15 A
Max. Snow Load (IEC 6125)	550 kg/m^2 (5400 Pa)
Max. Wind Load (IEC 6125)	244 kg/m^2 (2400 Pa)

POWER DATA @ STC	280 WP Black backsheet	285 WP White backsheet
Nominal Power - P_{MPP} (Wp)	280	285
Watt Class Sorting – (W)	0/+5	0/+5
Nominal Power Voltage – V_{MPP} (V)	32.32	32.2
Nominal Power Current – I_{MPP} (I)	8.66	8.85
Open Circuit Voltage – V_{OC} (V)	39.8	30.7
Short Circuit Current – I_{SC} (A)	9.22	9.46
Fill Factor (%)	76.3	76
Panel Efficiency (%)	17.04	17.34

Analyzed data demonstrated that 99.7% of panels produced have current and voltage tolerance of ±3% from nominal value
Values at standard test conditions STC (airmass AM 1.5, irradiance 1000 W/ m^2, cell temperature of 25°C).
At low irradiance of 200 W/ m^2 (AM A.5 and cell temperature 25*C) at least 97% of the STC panel efficiency will be achieved.

Extended electrical parameters

White backsheet power data @ STC											
Nominal Power - P_{MPP} (Wp)	305	300	295	290	285	280	275	270	265	260	255
Watt Class Sorting – (W)	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage – V_{MPP} (V)	33.30	33.03	32.75	32.47	32.20	31.92	31.64	31.37	31.09	30.81	30.54
Nominal Power Current – I_{MPP} (I)	9.18	9.10	9.03	8.95	8.87	8.79	8.71	8.63	8.55	8.47	8.39
Open Circuit Voltage – V_{OC} (V)	40.61	40.39	40.18	39.96	39.75	39.54	39.32	39.11	38.89	38.68	38.47
Short Circuit Current – I_{SC} (A)	9.69	9.63	9.57	9.51	9.45	9.39	9.33	9.26	9.20	9.14	9.08
Fill Factor (%)	77.56	77.13	76.70	76.27	75.85	75.42	74.99	74.56	74.13	73.71	73.28
Panel Efficiency (%)	18.56%	18.25%	17.95%	17.65%	17.34%	17.04%	16.73%	16.43%	16.13%	15.82%	15.52%

Black backsheet power data @ STC											
Nominal Power - P_{MPP} (Wp)	305	300	295	290	285	280	275	270	265	260	255
Watt Class Sorting – (W)	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5	0/+5
Nominal Power Voltage – V_{MPP} (V)	33.70	33.43	33.15	32.88	32.60	32.32	32.05	31.77	31.49	31.22	30.94
Nominal Power Current – I_{MPP} (I)	9.06	8.98	8.90	8.82	8.74	8.66	8.58	8.51	8.43	8.35	8.27
Open Circuit Voltage – V_{OC} (V)	40.86	40.65	40.43	40.22	40.01	39.79	39.58	39.36	39.15	38.94	38.72
Short Circuit Current – I_{SC} (A)	9.52	9.46	9.40	9.34	9.28	9.22	9.16	9.10	9.04	8.98	8.92
Fill Factor (%)	78.47	78.04	77.61	77.19	76.76	76.33	75.90	75.47	75.05	74.62	74.19
Panel Efficiency (%)	18.56%	18.25%	17.95%	17.65%	17.34%	17.04%	16.73%	16.43%	16.13%	15.82%	15.52%

VIII. EC DECLARATION OF CONFORMITY

Norwegian Crystals AS declares under its sole responsibility that the solar panels/modules it produced meet the following standards and technical specifications:

IEC/EN 61215 : 2005	Crystalline silicon terrestrial photovoltaic (PV) modules – Design and qualification and type approval
IEC 61215 (ed. 2)	
IEC 61730-1 : 2004	Photovoltaic (PV) module safety qualification
IEC 61730-2 : 2004	
IEC 61730 (ed. 1)	
IEC 61730 (ed. 2)	
EN 61730 -1 (2007)	
EN 61730 -2 (2007)	

And therefore comply with the EC Directive LDV 2006/95/EC (Low Voltage Directive), DIN EN ISO 11925-2 and 204/108/EEC.

The regulations for Safety Class II are an integral part of the Standard IEC 61730.

Reidar Langmo
Chief Executive Officer
Norwegian Crystals AS

Oslo, Norway, September 1 2014

IX. DOCUMENTATION HISTORY

DATE	REVISION	REASON
01.09.2014	I.	First release
01.01.2015	II.	Graphic Updates